# Nuclear Science Division Newsletter

**In this issue:** **October, 2015**



## GRETINA: A success in three states. And Counting.

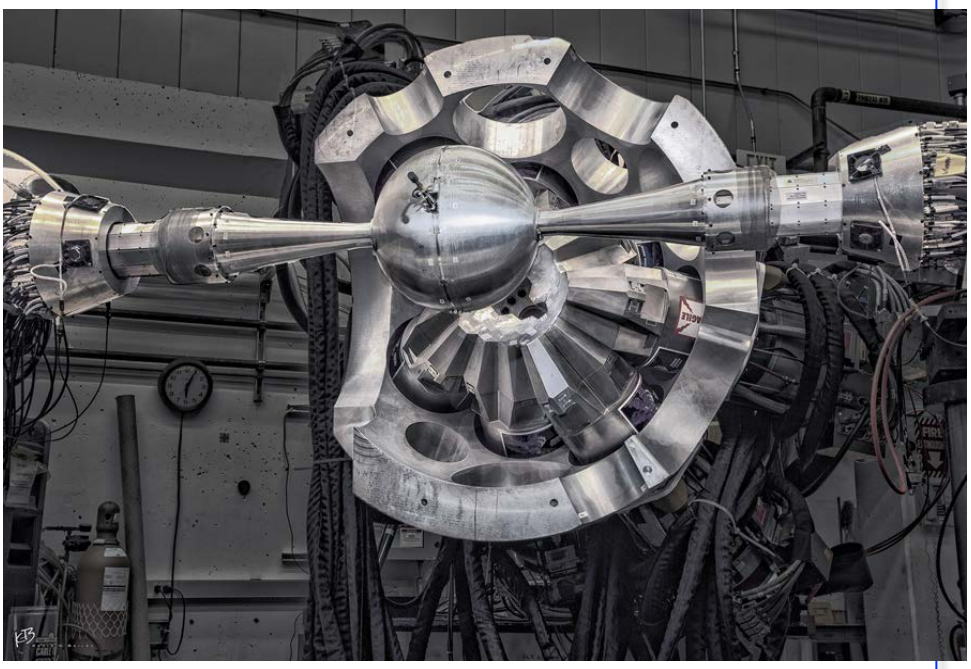


**Figure 1. GRETINA and the CHICO2 particle array, set up on the APEX line at Argonne National Laboratory.**

The first campaign of GRETINA at ATLAS (ANL) has just come to an end and the array is once again on the move, currently being set-up for a second science campaign at NSCL (Michigan State University). After the initial engineering/commissioning runs here at Berkeley, the two completed scientific campaigns show GRETINA to be a resounding scientific success thus far. The GRETINA users community and the GRETINA project team here at LBNL are looking forward to this next fast-beam campaign at NSCL.

In a little over a year at ATLAS, GRETINA was used over a total of approximately 130 days of beam time devoted to 18 PAC-approved measurements involving more than 100 scientists from 15 institutions. Coulomb excitation measurements using ATLAS beams from CARIBU, with GRETINA coupled to the CHICO-2 counter array (see Fig. 1) were a cornerstone of the campaign, constituting a large fraction of the research program that focused on the nature of collective excitations, the onset of collectivity, the search for evidence of triaxiality and the determination of octupole strength. In addition, the full range of measurements included deep-inelastic reactions, transfer reactions with stable beams, and a number of characterization measurements dedicated to studies of the intrinsic capabilities of GRETINA itself.

One highlight of the campaign came with the use of GRETINA as a gamma-ray polarimeter to determine the electric or magnetic character of a transition. A characterization study using proton inelastic scattering on $^{24}$Mg to populate the first $2^+$ state in this nucleus is summarized in Fig. 2. The decay from this $2^+$ state proceeds via a highly polarized E2 transition, for which GRETINA showed outstanding sensitivity. This measurement was led by LBNL, as was a subsequent physics measurement aimed at determining the nature of the low-energy enhancement in the gamma-ray strength function of $^{56}$Fe. With the sensitivity of GRETINA as a polarimeter proven, the array continues to confirm its position as a world-leading gamma-ray spectrometer.

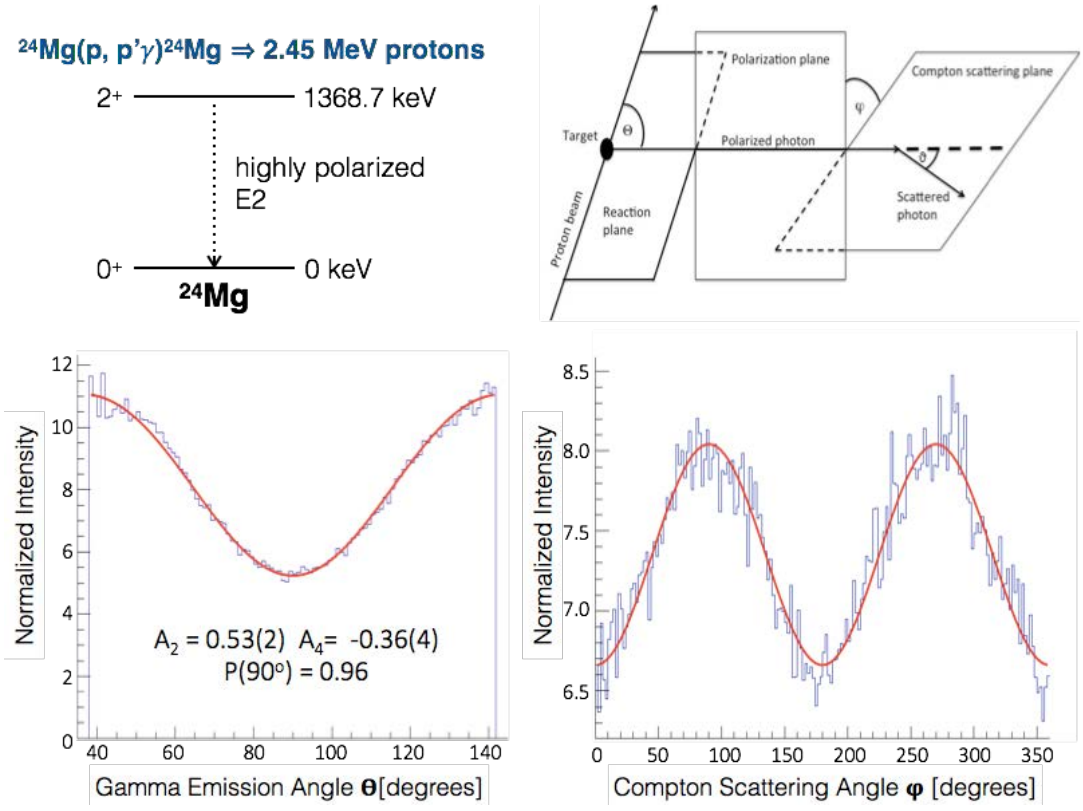
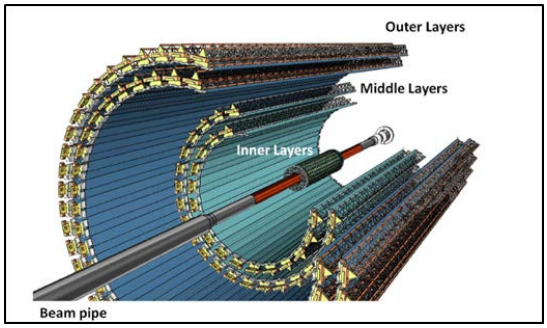



**Figure 2 Polarization with GRETINA. A characterization measurement at ANL showed the outstanding capabilities of GRETINA for measurement of gamma-ray polarization. Bottom left panel: angular distribution of the 1.37 MeV gamma-ray; bottom right panel: azimuthal angle distribution of the polarized photon compared to the expectation from the Klein-Nishina formula.**

## ALICE upgrades for precision tracking




The ALICE detector at CERNs Large Hadron Collider will undergo a major upgrade during the 2019 LHC Long Shutdown. As part of this upgrade, the ALICE Inner Tracking System (ITS) will be replaced by an entirely new detector, comprising seven concentric cylinders of MAPS sensors, about 10 square meters of silicon (left), making a 25 giga-pixel charged particle camera.

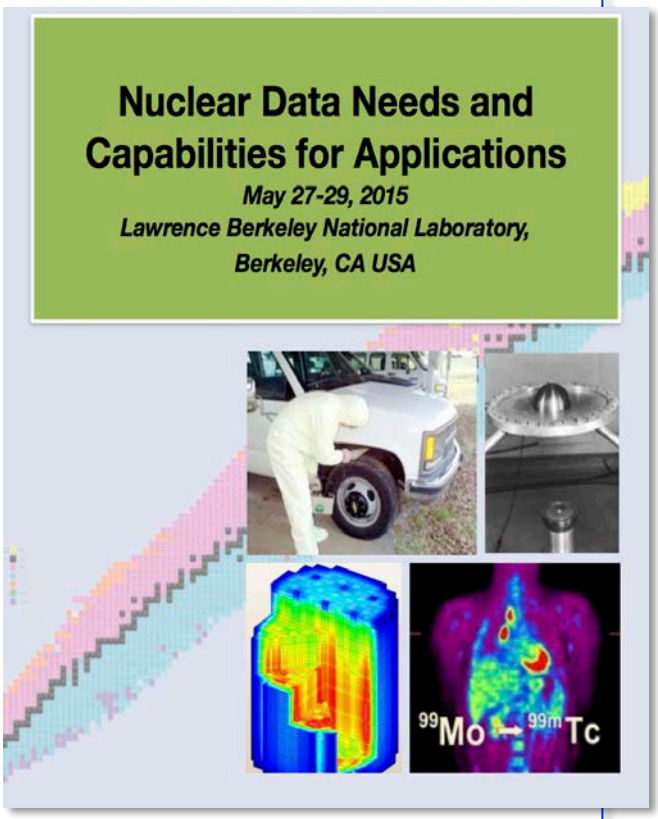
A key goal of the ALICE upgrade is a qualitative improvement in the measurement of charmed mesons and baryons in heavy ion collisions, to study both collective behavior of heavy flavor and to explore the dynamics of heavy flavor in jets. This goal imposes a stringent requirement of 0.3% radiation length per layer in the three innermost ITS layers, with slightly relaxed requirements for the middle and outer layers. This challenge is being met using ultra-thin low-power MAPS sensors which have ~50 μm thickness, less than 100 mW $cm^{-2}$ power dissipation, and 30 um pixel pitch. The impact parameter resolution for the upgraded ITS is projected to be 40 μm for tracks with $p_T$ = 500 MeV/c, three times better than the existing ALICE ITS. In order to utilize the full upgraded LHC luminosity and meet the ALICE physics goals, the new ITS will have to be read out at 50 kHz in Pb-Pb and 200 kHz in pp; this is also being achieved with the new sensors and system design.

The upgraded ITS is the direct successor to the STAR Heavy Flavor Tracker. The ALICE-USA effort for the ITS upgrade project, which is led by NSD scientists, has primary responsibility for the two middle layers, development of the power system for the full ITS, and engineering and construction of composite materials support structures. Current NSD effort is focused on development of the power system, power bus prototyping, and testing of prototype MAPS sensors.

The first-generation power system is nearing completion at LBNL and will be distributed to collaborating institutions by October. The next generation systems, for testing of seven modules and for the full system, are under development at LBNL, in collaboration with CERN and other ITS institutions. Power distribution requires an aluminum power bus to minimize radiation length, which is technically very challenging. Three different bus designs are being prototyped, by CERN, a commercial firm in the US, and another ALICE institution. RNC has extensive experience in this area and is playing a leading role in testing and QA-ing these prototypes, with final selection expected within a year.

This summer saw a significant RNC effort for irradiation and testing of the ITS prototype ALPIDE-1 sensor at the Berkeley Accelerator Space Effects (BASE) facility at the 88-inch cyclotron. The photo shows Fernando Acosta, one of three undergraduate students working with Leo Greiner, Barbara Jacak and NSD postdoc Alberto Collu on this project. A detailed set of measurements mapped the ALPIDE-1 latch-up sensitivity to radiation and characterized its analog and digital response. These data are crucial input to the ongoing design and optimization of the ALPIDE sensor.

## Applications drive Nuclear Data forward

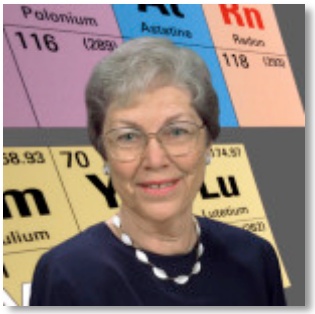



Nuclear physics is fundamentally important to a wide range of applications that are critical to human welfare ranging from the generation of energy, to the treatment of illness to national (and international) security.

Unfortunately, the rich complexity of nuclear physics has resulted in a lack of predictive capabilities accurate enough to serve the needs of the applications communities. So, nuclear physics applications have always depended on the measurement, publication, compilation and evaluation of nuclear data. The US Nuclear Data Program (USNDP) within the DOE Office of Science/Nuclear Physics (DOE-SC/NP) is charged with this task and to "*Develop mechanisms to assess community data needs*". In response to this mission, the LBNL branch of the USNDP, together with the Nuclear Science and Security Consortium at UC Berkeley, organized a Nuclear Data Needs and Capabilities for Applications workshop (NDNCA), which was held at Lawrence Berkeley National Laboratory (LBNL) on 27-29 May 2015. Nearly 100 researchers from across the country attended the workshop. The agenda and talks are posted at http://bang.berkeley.edu/events/NDNCA/agenda.

The primary outcome of the workshop was a whitepaper, which summarized all of the data, needs for applications and specifically called out "crosscutting" topics areas. These range from fundamental science topics including neutron interactions with matter and a better understanding of the fission process, to more "engineering-centric" needs like improved dosimetry standards and decay data. This whitepaper will provide guidance to DOE-SC/NP and partnering government offices in updating their funding directions and serve as a useful tool in the nuclear data community's strategic planning process.

## Fragments




NSD senior scientist emeritus Darleane Hoffman has been awarded the Los Alamos medal for her "exceptionally distinguished career in nuclear science, actinide chemistry and separations and her pioneering work at the frontier of the periodic table." Awarded by Los Alamos National Laboratory, the medals are awarded to those who have contributed to LANL at the highest level; past winners include Hans Bethe and Harold Agnew. Hoffman distinguished herself there over a 25 year career before she moved to Berkeley in 1984.

**The annual NSD Picnic was held on August 13, at Codornices Park in Berkeley. It was well-attended by NSD staff as well as other luminaries at LBNL.**

## Newsletter Notes

Please send any comments, including story suggestions to Spencer Klein at srklein@lbl.gov.

Previous issues of the newsletter are available at:
https://commons.lbl.gov/display/nsd/NSD+Newsletter

Newsletter layout of current and previous issues by Sandra Ritterbusch.